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PATENT SPECIFICATION

NO DRAWINGS

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COMPLETE SPECIFICATION

Improvements in or relating to the Manufacture of Particle Boards

We, CIBA (A.R.L.) LIMITED, a British Company of Duxford, Cambridge, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

THIS INVENTION relates to the manufacture of particle boards.

Particle board is manufactured by coating wood chips, or other cellulosic particles, such as bagasse, flax shives, cotton stalks, rice husks or the like with a liquid urea-formaldehyde or phenol-formaldehyde resin and optionally a hardener therefor, and consolidating under pressure the resultant mass at ambient temperature. The matrix so obtained is then transferred to another press and heated under a higher pressure a further consolidate the particles and simultaneously cure the resin. A rigid, dense board results.

The initial mechanical strength or rigidity of the matrix, the so-called "green strength," is low, and rapidly diminishes, the rate of diminution being dependent on such factors as the ambient temperature and relative humidity. Under the usual manufacturing conditions the green strength may be negligible by the time the matrix is transferred to the hot press.

It is desirable that the green strength be high and be retained for a considerable period. This permits the cold-pressed matrix to be slid off the caul plate into the hot press without deforming or disintegrating. According to present practice, since the matrix is very friable, it is usually carried on the caul plate into the hot press. This results in loss of production time, as the caul plate must be allowed to cool after the hot pressing stage is completed before it can be reused. A further advantage of high green strength is that the matrix retains its original shape during transfer to the hot press, and the finished boards are consequently more uniform. Yet a further advantage is that the matrix can be better consolidated before transfer to the hot press. A hot press with smaller daylights, and hence of lower capital cost, may therefore be employed. Alternatively, since the matrices are thinner, more may be accommodated in a press occupying a given floor area thereby increasing the rate of production of the finished boards.

It has now been found that the rate of dimunition in the green strength may be retarded, and the green strength itself enhanced, by incorporating in the matrix gelatine or casein, as an aqueous solution.

This invention accordingly provides a process for the manufacture of particle boards and the like which comprises coating cellulosic particles with a liquid urea-formaldehyde or phenol-formaldehyde resin, optionally with a hardener for the said resin, and with an aqueous solution of gelatine or of casein, consolidating the coated particles under pressure, at a temperature at which the resin does not cure, to form a matrix, and hot-pressing the matrix to cure the said resin and further consolidate the particles. The term "gelatine" as used herein comprises materials derived from collagen, including those products commonly referred to a animal glues.

Preferably, the gelatine or casein is applied to the particles at the same time as the resin and optional hardener. It is within the scope of the invention however to apply the gelatine or casein, the resin and the hardener (if any) to the particles in any sequence, provided particles are coated with the gelatine or casein before they are consolidated to form a matrix. It is, of course, possible (and within the scope of the invention) to coat the particles with both gelatine and casein though no advantage usually accrues from this.

It has also been found that incorporation of the gelatine solution is facilitated by addition thereto of urea. It is believed, although

the invention does not depend on the truth of this belief, that the effect of addition of urea is to solubilise the gelatine, and also to protect the gelatine against insolubilisation by free formaldehyde present in the resin. The urea may be present as excess urea in the liquid urea-formaldehyde resin solution, but better results are obtained by adding urea separately to the gelatine solution. In a preferred embodiment, therefore, the particles are coated with a liquid urea-formaldehyde resin and an aqueous solution of gelatine stabilised by containing urea, and optionally also with a hardener for the said resin.

The following Examples will serve to illustrate the invention. "Parts" designates parts by weight unless otherwise indicated. The green strength retention times given were those estimated by the operator. The values have no absolute significance but are nevertheless mutually comparable.

EXAMPLE I

A conventional adhesive formulation "A" was prepared as follows:

Resin I	84.5	parts
Urea	11.4	,,
Hardener I	10	,,
Water	14	,,

Resin I denotes a liquid resin prepared by reacting urea and formaldehyde in a molar ratio of 1:1.88 under mildly acid conditions, the extent of reaction being such that 5 parts by volume of the resin tolerate 6.5 parts by volume of water at 18°C., and evaporating the reaction mixture under vacuum until the solid content is 69% W/W and the viscosity 70 poises at 21°C.

Hardener I comprises 1.5 parts of ammonium chloride, 2.5 parts of hexamethylene tetramine and 96 parts of water.

Formulation "B" contained

Resin II	100	parts

and 30 parts of a mixture comprising

Gelatine, 150 m.p.s. grade	9	,,
Urea	4	,,
Hardener I	10	,,
Water	30	,,

Resin II was prepared by adding 13.5 parts of urea and 4.8 parts of water to 100 parts of Resin I: the resultant mixture had a viscosity of 17 poises at 21°C.

Formulations "A" and "B" were each then added to 1000 parts of wood chips and the resultant masses consolidated under pressure at room temperature, the thickness of the masses being reduced from about 8 cm. to 4 cm. in the process.

The matrix prepared with formulation "A" and containing 7% by weight of urea-formaldehyde resin (calculated as 100% solids) on the weight of wood chips had a green strength retention time of 10-15 minutes.

The matrix prepared from formulation "B" and containing, on a similar basis, 7% of urea-formaldehyde resin and 0.5% gelatine had a green strength retention time of 30 minutes.

EXAMPLE II

Formulation "C" was prepared from the following mixtures:

a.	Resin I	72.5	parts
	Urea	1.8	,,
b.	Gelatine, 150 m.p.s. technical grade	10	,,
	Urea	8	,,
	Hardener I	19	,,
	Water	30	,,

The formulation was added to wood chips (1000 parts) as described in Example I, the content of resin (calculated as 100% solids) being 6% and that of the gelatine 1%. The green strength retention time was again about 30 minutes.

Boards prepared with formulation "C" had superior properties to those prepared with the control formulation "A," as shown in the following table:

Formulation	Used
A	C
Modulus of rupture (kg./sq.cm.)	152	198
Delamination strength (kg./sq.cm.)	4.4	6.7

The modulus of rupture and the delamination strength were determined as described in British Standard 1811 : 1961. The boards were prepared by curing the matrices for 6 minutes at 145°C. under a pressure of 24.6 kg./sq.cm.

Example III

Wood particle boards were made as described in Example II, various grade of gelatine being employed. In each experiment (designated 1 and 2 below), a control resin-hardener formulation (A: as in Example 1) and a resin-hardener-gelatine formulation (C: as in Example II) were employed. In each experiment the boards were prepared under constant conditions of temperature and relative humidity, but the conditions in the two experiments were not the same. The curing conditions were the same as in Example II, the resultant boards being 1.25 cm. thick. The moduli of rupture and delamination strengths of the cured boards were determined as in Example II.

1.

	Formulation (A)	Formulation (C)		
Grade of gelatine	—	100 m.p.s.	120 m.p.s.	140 m.p.s.
Green strength retention time (minutes)	15 - 18	33 - 38	19 - 22	22 - 25
Modulus of rupture kg./sq.cm.)	150	160	193	153
Delamination strength (kg./sq.cm.)	8.4	7.7	7.4	7.4

2.

	Formulation (A)	Formulation (C)		
Grade of gelatine	—	Bone glue No. 2	Bone glue No. 4	150 m.p.s. edible grade
Green strength retention time (minutes)	2	13 - 15	25	17 - 19
Modulus of rupture (kg./sq.cm.)	167	162	156	152
Delamination strength (kg./sq.cm.)	6.9	4.2	5.6	4.6

It can be seen that the green strength retention time is in each case considerably increased by the inclusion of gelatine in the resin mixture and that the mechanical strength of the cured board prepared by the new process may even be superior to that prepared by a conventional method.

EXAMPLE IV

A conventional adhesive formulation "D" was prepared from:

Resin II	100	parts
Hardener II	10	,,
Water	10	,,

Hardener II comprises 10 parts of ammonium chloride and 90 parts of water.

Formulation "E" was prepared by mixing:

Hardener II	10	parts
Soluble Casein	10	,,
Aqueous ammonia solution (S.G., 0.880)	5	,,
Urea	5	,,
Water	15	,,

and adding this mixture to 86 parts of Resin II. (The aqueous ammonia was added to solubilise the casein).

The formulations were then each added to 1000 parts of wood chips and the resultant masses consolidated.

The matrix prepared from formulation "D" contained 7% by weight of resin solids and had a green strength retention time of 50 minutes, while that prepared from formulation "E" contained 6% by weight of resin solids and 1% of casein, and had a green strength retention time of 120 minutes.

EXAMPLE V

A conventional adhesive formulation "F" was prepared from:

Resin II	100	parts
Hardener III	10	,,
Water	15	,,

Hardener III comprises 10 parts of ammonium chloride, 10 parts of aqueous ammonia solution (S.G., 0.880) and 80 parts of water.

Formulation "G" was prepared by mixing:

Hardener II	10	parts
Soluble Casein	10	,,
Aqueous ammonia solution (S.G., 0.880)	1	part
Urea	5	parts
Water	15	,,

and adding this mixture to 100 parts of Resin II.

The matrix prepared from formulation "F" had a green strength retention time of 35 minutes, whereas that prepared from formulation "G" had a green strength retention time of 100 minutes.

WHAT WE CLAIM IS:

1. Process for the manufacture of particle boards and the like which comprises coating cellulosic particles with a liquid urea-formaldehyde or phenol-formaldehyde resin, optionally with a hardener for the said resin, and with an aqueous solution of gelatine or of casein, consolidating the coated particles under pressure, at a temperature at which the resin does not cure, to form a matrix, and hot-pressing the matrix to cure the said resin and further consolidate the particles.

2. Process according to claim 1 wherein the gelatine or casein is applied to the particles at the same time as the resin and optional hardener.

3. Process according to claim 1 or 2 wherein the particles are coated with a liquid urea-formaldehyde resin and an aqueous solution of gelatine stabilised by containing urea, and optionally also with a hardener for the said resin.

4. Process according to any of claims 1 to 3 substantially as described in the Examples.

5. Particle boards prepared by the process claimed in any of claims 1 to 4.

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